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Operation Manual for the Four-foot Integrating Hemisphere, Laurel

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This document describes the state of the four-foot integrating hemisphere source, known as Laurel, located at the NASA GSFC Code 920.1 Calibration Facility. Additionally, this document outlines the operation procedures for this source.

Keywords: Laurel, Four-foot Integrating Hemisphere, Integrating Sphere, Power Supply

1.0 Introduction and General Description

1.1 General Description

The integrating hemisphere source consists of two parts: a 42” diameter hemispherical source and a source system power supply (Figure 1).

Figure 1 - The Laurel Source System.

The hemisphere is a hollow spun aluminum hemisphere with a black anodized faceplate. The hemisphere is mounted to a support frame. The faceplate has a 30” square opening, and a grooved rail. To define the exit aperture, plate with a 10” diameter aperture is placed into the grooved rail. Mounted symmetrically around the perimeter of the

hemisphere, sixteen (16) 100-watt quartz tungsten halogen lamps, GE type Q6.6A/T3/CL. A trumpet baffle is mounted so that light from the lamps does not directly exit the aperture. Several coats of $BaSO_4$ cover the hemisphere interior and the baffle, providing a higlhy diffuse and reflective surface. The hemisphere faceplate is black anodized aluminum, and is not coated with $BaSO_4$.

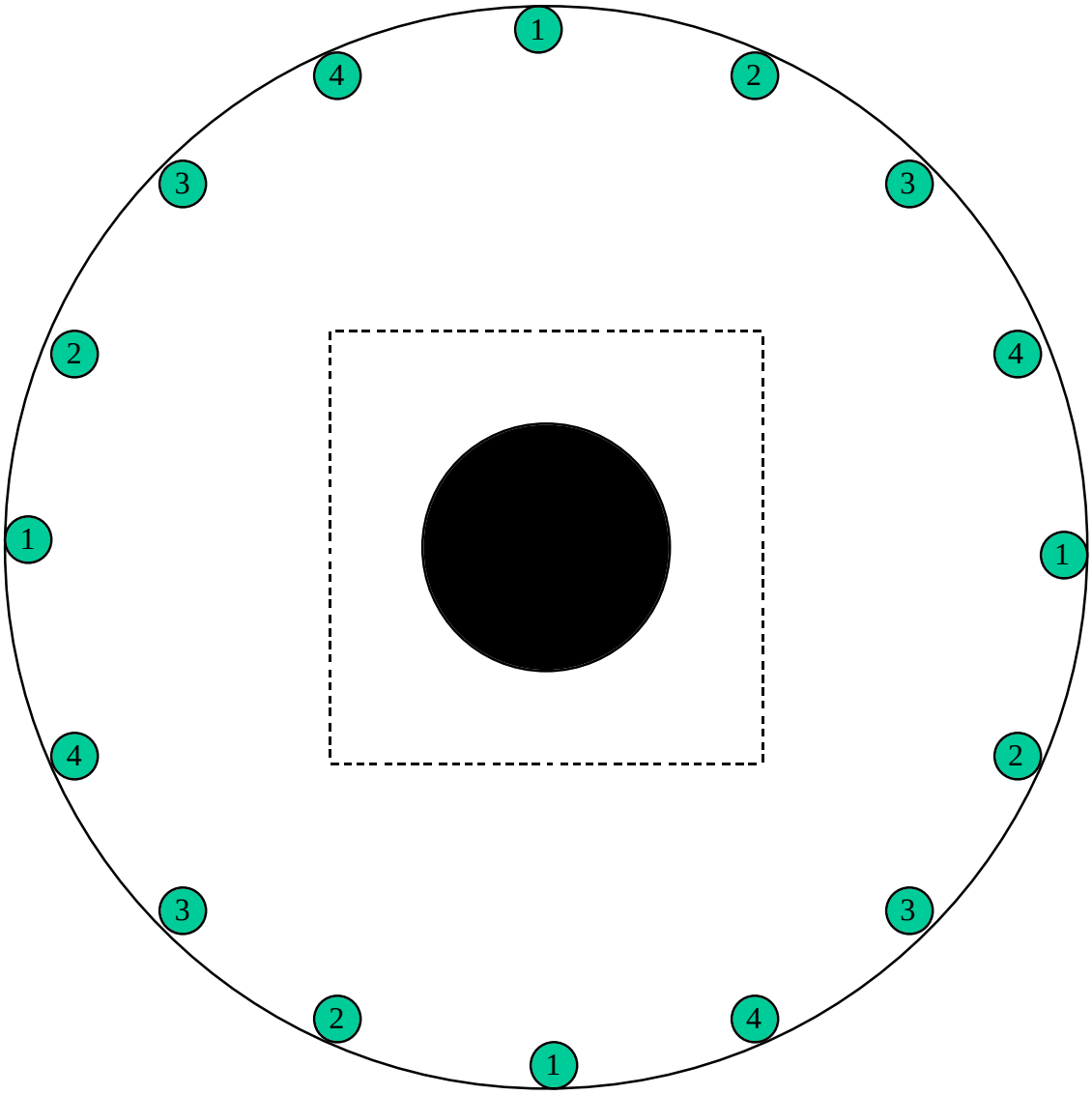


Figure 2 - Laurel Arrangement

Sixteen 100-watt lamps are significant heat sources. Hemisphere cooling is purely convective; there is no forced air movement. To permit this convective cooling to occur, the trumpet baffle is spaced approximately 1/2” from the hemisphere shell, and the faceplate is spaced approximately 1/4” from the trumpet baffle.

The source system power supply includes a multimeter, four power supplies, and shunt resistors. Current through the lamps is set by potentiometers on the control panel.

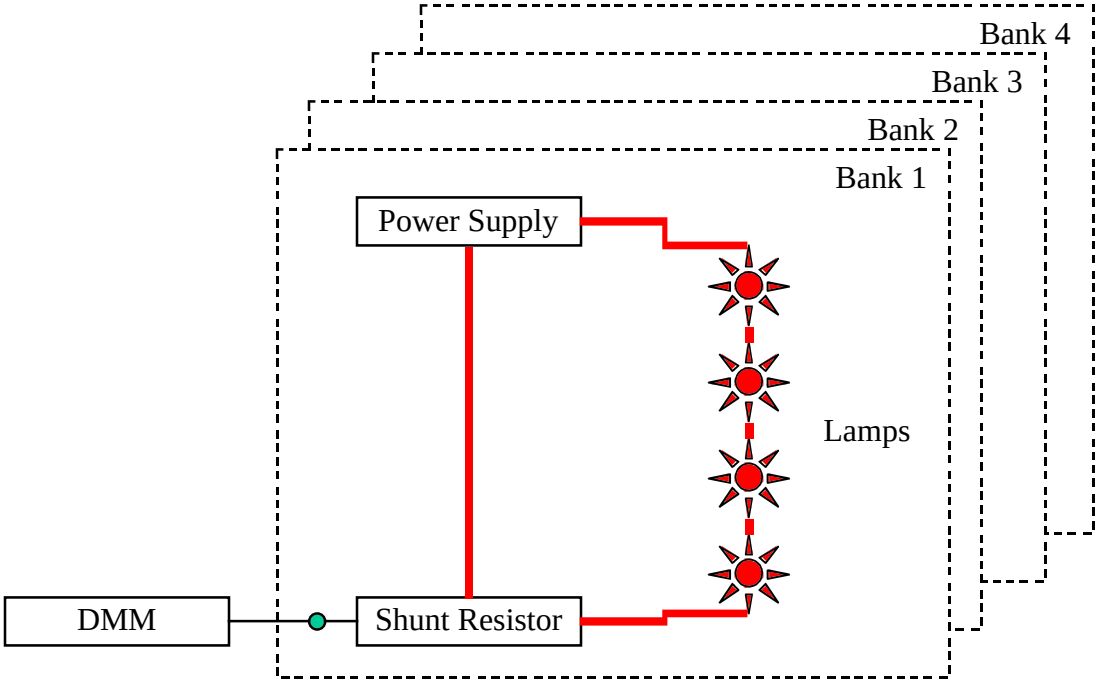
1.2 Electonic Components
The primary components of the source system power supply are:

- Four DC lamp power supply units, Kikusui PAD70-8L.
- Four shunt resistors.
- One digital multimeter, Keithley 8842.

1.3 Circuit Theory
The DC lamp power supplies are operated in the constant current mode, sourcing current through four lamps each. Additionally, a standard 0.01Ω ammeter shunt is in series with the lamps. The combination of power supply, lamps, and shunt is referred to as a lamp bank. The power supply output current is set by current level potentiometers on the power supplies. Figure 3 is the electrical block diagram for Laurel.

The shunt outputs are connected to a banana-jack pair, to which the DMM input is connected. The DMM measures a voltage proportional to the current through the shunt.

The DMM measurement is used by the operator to adjust the current for the bank. The operator performs this adjustment by twiddling the control panel potentiometers.



Items within the dashed box are duplicated for each bank.
The red line indicates the controlled current loop.
The green spot represents a banana plug for the DMM signal cable.

Figure 3 - Laurel Electrical Layout

2.0 System Installation and Operation
2.1 Installation requirements

2.1.1 Power
Two standard 120V, 20A, 60Hz circuits are required. Two lamp power supplies are connected to each power circuit.

2.1.2 Interconnection
Four cables connect the lamp power supplies to the lamp banks through banana jack connections. The cables are terminated with banana plugs, numbered 1 through 4. Color coding indicates polarity.

2.2 Initial Control Settings

2.2.1 Lamp Power Supplies
Power Breaker – OFF
Voltage knob – Fully clockwise
Current knob – Fully counter-clockwise

2.2.2 Instruments
DMM – ON

2.2.3 Control Panel
Potentiometers – Fully counter-clockwise

2.3 System Operation

2.3.1 Preparation
Verify that all four lamp power supplies are OFF by checking the power breaker on the power supply front panel is in the OFF (down) position (Figure 4). Verify that all voltage and current potentiometers are set to the initial settings position.

Verify that the DMM is on. When power is applied, the DMM display will light up.

The system is now ready for operation.

2.3.2 Startup
Plug the DMM into shunt connection #1, as shown in Figure 4.

Figure 4 - Laurel Control Panel

On power supply #1, set the power breaker ON, and ensure the CV or CC lamps illuminate. Adjust the current control until the DMM display reads 65.1mv. This adjustment is done by slowly turning the current control clockwise until the correct reading is displayed on the DMM. This current ramp-up should take approximately one minute.

Allow the system to warm up and stabilize for 30 minutes. After the warm up, the current should be re-adjusted to the nominal level.
Repeat these steps for lamp banks 2, 3, and 4. When complete, all banks will be on, and the power supplies will appear as in Figure 5

Figure 5 - Laurel Power Supplies turned ON

2.3.3 Shutdown

2.3.3.1 Standby Shutdown
To place a bank in standby mode, adjust the current control to the zero level. This is done by slowly turning the control panel potentiometer control counter-clockwise until reaching the stop. Do not turn off the supply mains to the supply.

To restart the bank, follow the startup procedure outlined in 2.3.2. When restarting, allow a five (5) minute warmup period, rather than 30 minutes required for a cold start.

2.3.3.2 Complete Shutdown
Zero the current output to each bank as outlined in procedure outlined in 2.3.3.1. When the supply is at zero output level, turn off the supply mains to the supply.

When all supplies are off, turn the DMM off.

2.3.4 Operation

2.3.4.1 Introduction

Operation of this spherical integrator source system is completely manual. There are four illumination levels.

2.3.4.2 Increasing the Current
To increase the current to a bank, connect the DMM to the appropriate shunt, and rotate the control panel potentiometer for that bank counter-clockwise. The target current is 6.51A, which corresponds to a DMM reading of 65.1mv.

2.3.4.3 Reducing the current
To decrease the current to a bank, connect the DMM to the appropriate shunt, and rotate the control panel potentiometer for that bank clockwise. The target current is 6.51A, which corresponds to a DMM reading of 65.1mv.

2.3.4.4 Turning Lamps Off
There are four authorized illumination levels for Laurel: 16, 12, 8, and 4 lamps. These illumination levels are achieved by turning banks off.

To turn a bank of lamps off, ramp down the current level, as described in 2.3.3.1.

The following table outlines the bank power supply states (on or off) to achieve the authorized illumination levels.

Number of Lamps ON	Power Supply #1	Power Supply #2	Power Supply #3	Power Supply #4
16	ON	ON	ON	ON
12	OFF	ON	ON	ON
8	OFF	OFF	ON	ON
4	OFF	OFF	OFF	ON

CAUTION: ALWAYS START AT THE 16 LAMP ILLUMINATION LEVEL, THEN GO TO 12, THEN 8, AND FINALLY 4.

2.3.4.5 Turning Lamps Back On
To turn a lamp bank back on, thus returning to a higher illumination level, ramp up the appropriate power supply or supplies, as described in section 2.3.3.1.

2.3.4.6 Shutting Down
To shut down the system:

Ensure all lamp banks are ramped down.

Turn the bank power supplies OFF.

Turn the DMM power switch OFF.